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Examining Self-Control as a Multidimensional Predictor of Crime and Drug Use in Adolescents with Criminal Histories

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Abstract

The general theory of crime posits that variability in propensities to engage in crime and deviance is partly a function of individual differences in low self-control (LSC). LSC is hypothesized to comprise of six subdomains: impulsiveness, preference for physical activities, risk seeking, self-centeredness, preference for simple tasks, and volatile temper. Using structural equation modeling, LSC was examined to determine if a global self-control measure or a multidimensional measure of its subdomains was a more salient predictor of violent and property crimes and drug use among adolescent male offenders ($n=317$). Only the multidimensional model adequately fit the data. Risk seeking predicted violent and property crimes, whereas volatile temper predicted violent crimes and drug use. The general theory of crime may obscure differences in the explanatory power of self-control subfactors for specific types of crime, especially within at-risk youth. Findings have implications for effective interventions among adolescent males with criminal histories.

According to the general theory of crime,¹ variation in the propensity to engage in crime and deviance is primarily a function of individual differences in self-control, which is conceptualized as a latent personality trait. Gottfredson and Hirschi¹ defined self-control as the degree to which a person is “vulnerable to the temptations of the moment” (p. 87). Those that are more vulnerable to these temptations are described as having low self-control.

Gottfredson and Hirschi¹ defined low self-control using six distinct characteristics: (1) the tendency to have a here-and-now orientation, preferring immediate reward with an inability to defer gratification, (2) a preference for physical rather than cognitive activities, (3) adventurousness and a preference for engaging in risky activities, (4) self-centeredness or insensitivity to the needs of others, (5) a preference for simple gratifications and avoidance of complex tasks, and (6) minimal tolerance for frustration, which is characterized as responding to conflict in a physical rather than verbal manner. Gottfredson and Hirschi¹ argued that low self-control arises from ineffective socialization early in life and is a stable trait that persists over the lifespan. Additionally, they view low self-control as the primary individual-level factor

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explaining criminal behavior, drug and alcohol abuse and dependence, and other forms of deviance.

In order to measure an individual's level of self-control, Grasmick and colleagues developed the low self-control scale (LSC).² The LSC contains 24 items arranged into six subscales: impulsiveness, preference for physical activities, risk seeking, self-centeredness, preference for simple tasks, and volatile temper. These subscales represent interpretations by Grasmick and colleagues of the tenets of Gottfredson and Hirschi's self-control construct.¹ Grasmick and colleagues' analyses of data collected during scale construction indicated that the LSC scale could not be explained by a single factor, but that a six factor solution was more appropriate. Despite this result, however, the authors stated that the six subscales of the LSC scale appear to tap a single personality trait, self-control, which appears to be a unidimensional construct. They also suggested that the total score on the LSC should be used as an indicator of low self-control rather than scores on the individual subscales.

Following Gottfredson and Hirschi's conceptualization of the general theory of crime¹ and Grasmick and colleagues development of the LSC scale,² a number of research studies were conducted to test the hypothesized causal relationship between low self-control and criminal or delinquent behavior. Many studies found support for the hypothesized relationship.^{3–8} Cauffman and colleagues found support for the theory that low self-control is predictive of delinquency in adolescents.⁹ Additional research has shown that low self-control significantly predicted recidivism among a population of adolescent offenders.¹⁰ Research has also provided support for the notion that high self-control predicts positive social interactions and negatively predicts criminal or delinquent behavior.¹¹

Some researchers and theorists have, however, disputed the general theory of crime and, as a result, the subsequent research findings that support the theory (for review see Marcus¹²). Additionally, there has been a controversy concerning the effect sizes reported in studies of the predictive power of the general theory of crime and the low self-control construct. In Pratt and Cullen's meta-analysis of the general theory of crime, only 18 of the 82 effect size estimates were drawn from offender samples, and although self-control had a significant mean effect on crime in these samples, its effect was significantly lower than those results drawn from community samples.¹³ One theory is that the measurement of low self-control as a unidimensional construct significantly limits its explanatory power. An alternative would be to conceptualize low self-control as a personality pattern rather than a single dimension that is comprised of multiple traits.

Preliminary research using various populations supports the hypothesis that low self-control is multidimensional and, as such, is better measured by multiple subfactors rather than an overarching unidimensional factor.^{6,7,14–17} For instance, Longshore⁵ and colleagues⁶ found a multidimensional self-control scale to be more useful with adult offender populations. However, researchers have employed different techniques and multiple versions of the LSC scale in attempts to measure this multidimensionality accurately.⁸

In addition, the type of population under study may also play a part in the mixed results, some of which favor the unidimensionality of low self-control and others which favor a multidimensional approach. It is critical to ascertain the usefulness and predictive power of self-control measures among those that are most at risk for further criminal behavior of a serious nature. It may be of more value to prevention and other intervention efforts to discern the differential predictive capability of particular subscales to predict criminal behaviors by those very individuals most likely to perform criminal behaviors in the future: those who have committed crimes in the past, especially youth.¹⁸

When initially proposing the general theory of crime, Gottfredson and Hirschi posited a direct link between low self-control and drug use when they stated that “people lacking self-control will also tend to pursue immediate pleasures that are *not* criminal; they will tend to smoke, drink, use drugs...” (italics in original).^{1(p. 90)} It follows then that low self-control should predict drug use. Ribeaud and Eisner¹⁹ found that two of the subdomains of low self-control, risk seeking and impulsiveness, and a low self-control second-order factor positively and significantly predicted drug use and delinquency in a general adolescent sample. Additional research has also found that low self-control is a significant predictor of drug use.^{20,21}

In an effort to provide some clarity to the measurement issues surrounding low self-control, this study attempts to replicate the findings from previous studies using similar methods and a similar conceptualization of low self-control. Additionally, this study extends prior research by using longitudinal data from a sample of adolescent males with criminal histories who are at risk for further criminal behaviors. Relationships between low self-control and violent crimes (e.g., robbery, assault, homicide, and rape), property crimes (e.g., burglary, theft, arson, forgery, and fraud), and drug use were examined.

The specific hypothesis tested was that if low self-control, as defined by Gottfredson and Hirschi¹ and measured by the LSC scale,² can be effectively measured as a single construct, the subdomains of low self-control, as represented by the six subscales, should not differentially predict the outcome behaviors and should not be better predictors of different outcomes than an overarching unidimensional low self-control construct. Further, a model with a unidimensional factor and a model with multiple subfactors should not be significantly different from each other when tested with confirmatory procedures.

Methods

Participants

The data were collected between 1991 and 1995 for an evaluation of Treatment Alternatives to Street Crime (TASC) programs in five US cities. TASC was designed to identify drug-using adult and juvenile offenders in the criminal justice system, place them in treatment, and monitor their progress. More details about the TASC study are available in previously published materials.²²

The original sample included data from both female and male offenders; however, research has shown that the psychometric properties of the low self-control scale are inadequate when the scale is administered to women.^{6,15} Female offenders were therefore excluded from this analysis. Therefore, the longitudinal data used in this analysis came from a sample of 317 adolescent male offenders who had complete records. The ethnic breakdown of this sample is 54.5% African American, 31.8% Caucasian, 8.9% Hispanic/Latino, and 4.8% other. Ages ranged from 12 to 18 ($M=16.1$, $SD=1.4$) years.

Measures

Low self-control, assessed at baseline, was measured with a modified version of the LSC.² The LSC scale contains six subscales: impulsiveness (IM), preference for physical activities (PA), risk seeking (RS), self-centeredness (SC), preference for simple tasks (ST), and volatile temper (VT). In this modified version, response options were changed from the four-point options in the original version to five-point options that included never, rarely, sometimes, often, and almost always. Additionally, PA was measured using three self-report items instead of four in the modified version, whereas the remaining five subscales were measured using the four self-report items contained in the original version of the LSC scale. This modification also included items that were reversed to control for response biases. Items were reverse-scored

when appropriate so that high scores represented low self-control. These modifications to the LSC scale were consistent with modifications made in previous studies using this scale.^{6,7,15,23}

Criminal behavior, measured 6 months after baseline, was separated into two categories: those crimes that involved damage or theft of property and those crimes that involved violence directed at other individuals. The criminal behavior variables represent the number of different crimes within each category that each individual reported committing in the last 6 months. For property crimes, seven specific crimes were assessed so scores could range from 0 to 7. For violent crimes, five specific crimes were assessed so scores could range from 0 to 5.

Drug use was measured 6 months after baseline. While completing the follow-up interview, participants were asked to report how many times in each of the previous 6 months they had used alcohol, marijuana, cocaine, and crack cocaine. The reports were summed across months and standardized for each drug. A linear combination representing drug use over the previous 6 months was then formed from the standardized scores of the separate drugs.

Previous research has shown that age is significantly associated with self-control and criminal and drug use behavior. More specifically, as individuals get older, self-control typically increases and criminal behavior typically decreases.^{10,24} In order to control for this effect, age was included in all models as a predictor variable.

Analyses

Using the EQS statistical software package (EQS),²⁵ three separate structural equation models were estimated using the previously established factor structure of the LSC scale. The first model, referred to as the unidimensional model, was estimated by summing the items loading onto each of the six subscales: IM, PA, RS, SC, ST, and VT, to create six measured variables, which loaded onto a single low self-control latent factor, which predicted the crime and drug use outcome variables. The second model, referred to as the multidimensional model, was estimated by loading the 23 measured variables onto their respective subscales, creating six latent variables: impulsiveness, physical activity, risk seeking, self-centeredness, simple tasks, and volatile temper. In turn, these six latent variables predicted the crime and drug use outcome variables. The third model, referred to as the second-order model, was estimated by loading the 23 measured variables onto their respective subscales, creating six latent variables, impulsiveness, physical activity, risk seeking, self-centeredness, simple tasks, and volatile temper, and then having these latent variables serve as indicators of a second-order latent variable, low self-control.

The advantages of using latent variable structural equation models are that they offer goodness-of-fit statistics that can confirm the hypothesized factor structure and the factor structure within the data. Latent variable structural equation modeling also allows for the examination of error-free constructs. Furthermore, alternative models can be compared through chi-square difference tests. Data were initially analyzed using the maximum likelihood (ML) estimation procedure; however, preliminary analyses indicated that the data violated the assumptions of multivariate normality under the ML solution, so the models were evaluated using the maximum likelihood robust (MLR) solution and the Satorra–Bentler (S–B) scaled χ^2 statistic.²⁶ The MLR solution, offered in the EQS software, is an alternative method of estimating the standard errors of parameters when assumptions of multivariate normality are not satisfied.^{27,28} This method is recommended when such violations are present in the data.²⁹

Nonsignificant values of the scaled χ^2 statistic are preferred; however, as any χ^2 distribution is sensitive to sample size, additional indicators of goodness-of-fit, the robust comparative fit index (RCFI) and the root mean squared error of approximation (RMSEA), were used.³⁰ The

RCFI has values that range from 0 to 1. Values of 0.95 and higher are considered preferable and indicate that 95% or more of the covariation in the data is reproduced by the hypothesized model. The RMSEA is an index that measures the amount of residual between the observed and predicted covariance structure. More specifically, the RMSEA, which also has values ranging from 0 to 1, is a measure of fit per degrees of freedom, controlling for sample size. RMSEA values of less than 0.06 indicate a relatively good fit between the hypothesized model and the observed data.

To improve overall model fit, nonsignificant paths between variables were trimmed, and a minimal number of supplementary correlated error residuals were added to the measurement model. Correlated error residuals were to be added to the model based on suggestions from the Lagrange Multiplier Test (LM test),³¹ which suggests additional relationships to add to models for fit improvement. Correlated error residuals were only added to the model if they were logical and theoretically plausible. Plausibility was determined by examining whether correlated items were related in idea and content.

Finally, an adjusted χ^2 difference test was used to compare the models.²⁶ A scaled χ^2 such as the Satorra–Bentler cannot be used directly for χ^2 difference testing of nested models because a difference between two scaled χ^2 's is not distributed as χ^2 . A relatively easy adjustment has been developed to counter this problem.

Results

Initial data screening indicated that the data were non-normally distributed. The analysis indicated that they were multivariately kurtose (Mardia's coefficient=85.68, normalized estimate $z=22.06$). As a result, the robust corrections were used for all analyses as explained above.

Unidimensional model

Table 1 presents the factor loadings, means, and standard deviations of the summed subscales of the LSC scale. In the unidimensional analysis, these subscales were used as indicators of a low self-control latent variable. The model in which low self-control, measured as a unidimensional latent construct, and age predicted violent and property crimes and drug use had very poor fit, χ^2 ($df=31$, $N=317$)=81.12, $p=0.00$; RCFI=0.83; RMSEA=0.09. Even after trimming and attempting significant model modification based on the results of the LM test, it was not possible to achieve adequate model fit. This indicated that the unidimensional factor comprised of the summed subscales, low self-control, was unable to predict the variance in the criminal behaviors and drug use of the participants adequately.

Multidimensional model

The multidimensional model of the LSC scale wherein the six subscales were used as six independent latent variables (impulsiveness, physical activity, risk seeking, self-centeredness, simple tasks, and volatile temper) was examined next. The individual subscale items served as the indicators for each latent variable. Table 2 presents the factor loadings, means, and standard deviations for the measured variables for the items in the confirmatory factor analysis. Table 3 presents the correlations among the variables in the multidimensional model before the path model was tested. This confirmatory factor analysis model, with no further model modification, achieved adequate fit statistics: χ^2 ($df=xx$, $n=317$)=424.4, $p<0.001$; RCFI=91.1; RMSEA=0.41.

Next, the multidimensional path model was tested in which each separate latent variable predicted the criminal behavior outcomes. Age was included as a predictor as well.

Nonsignificant paths were trimmed from the model. This procedure resulted in a final path model (see Fig. 1) in which the risk-seeking subfactor significantly predicted both violent crimes and property crimes but not drug use; volatile temper significantly predicted violent crimes and drug use, but not property crimes; and age significantly and negatively predicted violent and property crimes and positively predicted drug use. The independent latent variables were allowed to associate freely, resulting in a significant correlation between risk seeking and volatile temper ($r=0.44$, $p<0.001$) and a significant and negative correlation between age and volatile temper ($r=-0.12$, $p<0.05$, one-tailed). The error residuals associated with the dependent variables were also allowed to associate freely, resulting in a significant correlation between the error residuals for property and violent crime ($r=0.37$, $p<0.001$). None of the other four subscales were predictive of property or violent crime or of drug use. This model also achieved excellent fit statistics: χ^2 ($df=39$, $n=317$)=41.51, $p=0.36$; RCFI=0.99; RMSEA=0.01.

Second-order factor model

The fit indexes for the model in which low self-control was conceptualized as a second-order latent variable [χ^2 ($df=308$, $n=317$)=565.01, $p<0.001$; RCFI=0.71; RMSEA=0.05] were inadequate and significantly worse than the multidimensional model: χ^2 difference test χ^2 ($df=240$, $n=317$)=491.59, $p<0.001$. While the second-order factor and age predicted violent and property crimes and drug use, the model fit was poor. Even after attempting significant model modifications, it was not possible to fit a model to the data. Thus, one overarching variable could not reflect the specific relations that existed in the data set.

Discussion

The analyses presented here revealed that only two of the subscales of the low self-control scale² significantly predicted property and violent crimes and drug use among adolescent already involved in the criminal justice system. Among this high-risk sample, volatile temper and risk seeking were the most important factors predicting further criminal behavioral outcomes longitudinally. Thus, the general theory of crime, which posits one principal factor of low self-control, may obscure important differences in the explanatory power of particularly relevant low self-control subfactors regarding specific types of crime among those individuals who are most at risk of further criminal behavior.

Benda,³² using the same instrument as the current study, reported a modest effect of cognitive global self-control in the prediction of delinquent behavior in a large normative data set. It may be more difficult to obtain such results with a specialized, non-normal sample with less variability such as the present one. However, this sample of young males who are already involved with the criminal justice system is more relevant and meaningful to those who study crime or who are developing intervention programs for youth at risk. Anti-social behavior is stable,³³ and detailed knowledge of specific predictors of juvenile criminal behavior may be more useful and relevant than broad global constructs in designing meaningful interventions. Furthermore, the current sample was longitudinal, which means that there could have been some attenuation of effects over time even though the longitudinal nature of this sample is a positive feature.

According to a report of the Office of Juvenile Justice and Delinquency Prevention,³⁴ most arrested juveniles have not committed serious or violent crimes but rather property crimes or status offenses. Violent juveniles are also likely to engage in significant property or drug-related crimes. The juvenile property crime arrest rate in 2002 was more than five times greater than the juvenile violent crime arrest rate. In the current study, property crimes were predicted by the risk-seeking subdomain. Interventions that target this particular aspect of low self-control may be more effective than generalized outreach programs in stemming further

delinquent or criminal behaviors and breaking the cycle of delinquent behaviors that eventually lead to adult criminal careers.

Volatile temper predicted both drug use and violent crime. Focusing on anger management for the adolescents who have shown a volatile temper may help in decreasing both drug use and continued violent criminal behavior. As with previous research, the link between constituent parts of low self-control and drug use was supported;¹⁸ however, in this population of juvenile offenders, it was volatile temper and age that significantly predicted drug use over the previous 6 months, not risk seeking. This may reflect differences in the different populations; the previous study used a non-offending population, whereas ours was a more relevant population that had already had some experience with the criminal justice system.

As expected, age was a significant negative predictor of the crime variables and a positive predictor of drug use. It was also significantly and negatively correlated with volatile temper. In this sample, however, age was not related to risk seeking. This is interesting as previous research indicates a strong negative association between age and risk seeking (for review, see Zuckerman³⁵). It is possible that the typical age–risk seeking relationship is different in this high-risk population or, more likely, that the range of ages in the current study is too restricted to observe this phenomenon. What is most important, however, is that, even after controlling for age, significant effects were still detected for volatile temper and risk seeking on the outcome variables, indicating that above whatever predictive power may have existed for the young age of our sample, relationships between constructs of low self-control and criminal behavior were also present.

The results of this study add to the growing body of literature that suggests that low self-control is not adequately explained by a single, overarching construct, but that it is better measured by its constituent parts, at least as they are defined in the widely used scale developed to measure self-control, the low self-control scale.² As in previous research,⁶ the subdomain of risk seeking played a strong role in our findings. In addition, at least in a sample of criminal offending adolescents, volatile temper was a significant factor. It was not possible to provide support for the other subdomains of low self-control, suggesting that they may be less salient for adolescent offenders. Those who work among adolescent offenders or conduct research within this population should be made aware of the specific relationships found by this analysis.

Limitations

It should be noted that there were several limitations to the findings of this study. The longitudinal data were from a sample of adolescent male offenders, which can limit the generalizability of the findings to similar populations; however, it can also be seen as a strength as this sample, in theory, should have much lower self-control and is the exact population that Gottfredson and Hirschi thought would show low self-control. If the factor structure does not hold in a sample that it was designed for, it is unlikely that it will hold for the general population unless there was severe range restriction in the sample, which was not the case in this study. Additionally, as with many studies, these data are non-experimental, thus, causality can not be asserted. However, based on the longitudinal nature of the data, predictive interpretations can be made based on temporal ordering of the variables. There is also the possibility that the interpretations could be attributed to certain non-measured or non-included variables, but again, this is a problem with which all non-experimental studies must contend.

Implications for Addictions Health Services

The findings from this research have implications for improving interventions to curb substance abuse and criminal behavior among adolescent males with criminal histories. Addictions health services research might be better served by focusing more on the most salient subfactors of

low self-control, which have concrete operational definitions rather than a general, loosely defined global construct of self-control. Attempting to target and to implement interventions based on a global self-control construct may be ineffective. Implementing prevention and intervention strategies that focus on specific subfactors may lead to more immediate and lasting behavior change, especially among adolescents.

The results indicate that mitigating both risk seeking and anger may successfully impact dysfunctional and deviant behaviors among adolescent males with criminal histories. For those adolescents who have already begun exhibiting criminal or drug use behaviors, interventions should include strategies to decrease the volatility of their tempers and moderate or channel their risk seeking into socially approved activities. Designing interventions that address anger management training are exciting and have some element of socially accepted risk, such as extreme sports or other exciting activities would be more likely to curb or supplant criminal and drug use behaviors in adolescent criminal populations and offset the negative consequences that often accompany these behaviors. This may be especially true for young males who were the focus of this particular study, as well as others who may not yet be involved with the criminal justice system but are at risk nonetheless.

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Figure 1.

Significant regression paths predicting violent and property crimes

The circles represent the latent variables: impulsiveness, violent/volatile temper, risk seeking, self-centeredness, simple tasks, and physical activities. Single-headed arrows represent regression paths, and double-headed arrows represent correlations. Regression coefficients are standardized. The model achieved excellent fit: χ^2 ($df=39$, $n=317$)=41.51, $p=0.36$; RCFI=0.99; RMSEA=0.01. Single asterisk $p<0.05$, double asterisk $p<0.01$, triple asterisk $p<0.001$

Table 1
Factor loadings, means, standard deviations, and alphas of the unidimensional model

	Factor loading	Mean	SD	α
Self-control latent variable				
Impulsiveness	0.50	7.05	2.54	0.27
Physical activity	0.38	7.68	2.56	0.56
Risk seeking	0.45	6.78	3.15	0.70
Self-centeredness	0.43	7.36	2.70	0.47
Simple tasks	0.33	7.38	2.79	0.48
Volatile temper	0.33	8.49	3.23	0.62
Age	—	16.07	1.44	—
Outcome variables				
Property crime	—	0.81	1.05	—
Violent crime	—	0.62	0.79	—
Drug use	—	0.09	1.98	—

Table 2

Factor loadings, means, and standard deviations of multidimensional model

Measured Item	Factor	Factor Loading	Mean	SD
You act on the spur of the moment without stopping to think	Impulsiveness	0.25	1.87	1.13
You devote a lot of thought and effort to preparing for the future ^a		0.13	1.67	1.12
You are more concerned about what happens to you in the long run than what happens right now ^a		0.16	1.65	1.18
You often do whatever brings you pleasure here and now, even at the cost of some distant goal		0.38	1.87	1.16
If you had a choice, you would rather do something physical than something mental	Physical activities	0.49	2.32	1.28
You feel better when you are on the move than when you are sitting and thinking		0.61	2.49	1.17
You like to get out and do things more than you like to read or think about ideas		0.49	2.82	1.09
You like to test yourself by doing something very risky	Risk seeking	0.66	1.83	1.33
You will take a risk just for the fun of it		0.79	1.48	1.28
You are very careful and cautious ^a		0.23	1.37	1.05
Security is more important to you than excitement or adventure	Self-centeredness	0.16	2.11	1.27
You look out for yourself first, even if it makes things tough on other people		0.31	2.51	1.22
You are very sympathetic to other people when they are having problems ^a		0.01 [*]	1.60	1.01
If things you do upset people, it is their problem, not yours		0.49	1.76	1.15
You will try to get things you want even when you know it is causing problems for other people		0.55	1.61	1.21
You try to avoid projects that you know will be difficult	Simple tasks	0.43	1.91	1.11
When things get complicated, you tend to quit or withdraw		0.48	1.60	1.15
The things in life that are the easiest to do bring you the most pleasure.		0.42	2.09	1.06
You like really hard tasks that stretch your abilities to the limit ^a		0.25	1.72	1.18
You lose your temper pretty easily	Volatile temper	0.69	2.42	1.21
You feel that the best way to solve an argument is to sit down and talk it out ^a		0.33	1.63	1.22
When you are really angry, other people better stay away from you		0.58	2.24	1.25
When you have a serious disagreement with someone, it is hard for you to talk about it calmly without getting upset		0.51	2.19	1.13
Age	Outcome variables	—	16.07	1.44
Property crime		—	0.81	1.05
Violent crime		—	0.62	0.79
Drug use		—	0.09	1.98

All items loaded onto their factors,

$p < 0.05$ unless noted

*
 $p > 0.05$, item did not load on factor

^aReversed items

Table 3
Correlations among the variables entered in the multidimensional model

	Age	IM	PA	RS	SC	ST	VT	PC	VC	DU
Age	—									
Impulsiveness (IM)	-0.07	—								
Physical activity (PA)	-0.05	0.17**	—							
Risk seeking (RS)	0.01	0.37**	0.17**	—						
Self-centeredness (SC)	-0.11*	0.21**	0.11*	0.09	—					
Simple tasks (ST)	-0.18**	0.23**	0.16**	-0.02	0.25**	—				
Volatile temper (VT)	-0.07	0.26**	0.17**	0.23**	0.37**	0.23**	—			
Property crime (PC)	-0.14**	0.13*	0.13*	0.25**	0.10	0.04	0.21**	—		
Violent crime (VC)	-0.16**	0.07	0.12*	0.19**	0.09	0.09	0.18**	0.39**	—	
Drug use (DU)	0.19***	0.18**	-0.05	0.08	0.05	0.06	0.13*	0.01	0.04	—

* $p < 0.05$;

** $p < 0.01$;

*** $p < 0.001$